Applicant Information

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Project Information

File Number: 19331

Application Status: **Application Complete - Issued**

Project Title: Application for a permit under the Endangered Species Act of 1973 to conduct scientific research on shortnose sturgeon (Acipenser brevirostrum) and Atlantic sturgeon (Acipenser oxyrhinchus oxyrhinchus) in the Delaware River and Estuary

Project Status: Renewal

Previous Federal or State Permit:

Permit Requested:
- ESA Section 10(a)(1)(A) permit (other)

Where will activities occur? US Locations including offshore waters

Research Timeframe: **Start:** 03/26/2015 **End:** 06/30/2021

Sampling Season/Project Duration: Sampling and other research activities would be conducted year-round for a period of 5 years. Frequency of sampling would be bi-weekly in the spring, summer, fall and winter months when temperature, ice, and dissolved oxygen levels is permissive of sampling.
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Abstract: We propose to characterize Atlantic and shortnose sturgeon and their habitat in the Delaware River (between rkm 0 to rkm 245), determining relative abundance, recruitment, temporal -spatial distributions, and reproduction, as well as assess the potential for entrainment and impingement of sturgeon life stages at industrial intakakes. Annual research activities would include capturing Atlantic and shortnose sturgeon adults, sub-adults and juveniles via gill net, trammel net, trawl net, trap nets (open to the surface), or beach seine. Other general research activities on all fish would include: measuring, weighing, sampling tissue (genetic analyses), scanning for tags, and inserting both Passive Integrated Transponder (PIT) and Floy/T-bar tags.

For shortnose sturgeon studies, we request annually capturing/re-capturing a set of up to 420 adults (x >550 mm TL) sub-adults (450 > x < 550mm TL), and juveniles (x < 450mm TL), and then anesthetizing two additional sets of 30 adults/sub-adults and 30 juveniles (300 mm > x < 450mm TL) and surgically implanting them with acoustic transmitters. An additional sub-set of 20 shortnose sturgeon adults/sub-adults would be tethered in a nylon sock for remote hydro-acoustic testing.

For Atlantic sturgeon, we request the annual capture/recapture of 430 juveniles (x < 600mm TL), including two sub-sets of 30 juveniles (300 mm > x < 600mm TL) anesthetized and implanted with telemetry tags, and 30 anesthetized and gastric lavaged juveniles. In addition, 70 adult/sub-adult (>600mm TL) Atlantic sturgeon would be captured with a sub-set of 20 of these that would be tethered in a nylon sock for remote hydro-acoustic testing.

Also, annual samples of 500 early life stages of both species would be collected. We also anticipate up to two incidental mortalities of each species (adults, sub-adults, and/or juveniles) each year, but no more than one adult of each species is anticipated during the 5-year permit.

Project Description

Purpose: Objectives:
This permit is being sought to continue and expand upon our past research on shortnose sturgeon and Atlantic sturgeon in the Delaware River and Estuary conducted by Environmental Research and Consulting (ERC) between 1999 and 2005 (respectively) through the present. Our prior shortnose sturgeon research was conducted under Permit Nos. 1174 and 1486, and our current Permit No. 14604, issued on April 20, 2010 and expiring on April 19, 2016. Our prior Atlantic sturgeon research has been ongoing since the 1996 moratorium on fisheries in the Delaware River and has been authorized by ESA Permit No. 16438 since April 2012 (expiring on April 5, 2017). The following discussion describes our individual objectives for both shortnose sturgeon and Atlantic sturgeon in the new permit (Permit No. 19331).

Summary of Shortnose and Atlantic Sturgeon Research Objectives:
Because the threats and recovery objectives are similar for both species, my proposed research tasks largely comport with the recommendations in the Final Recovery Plan for the Shortnose Sturgeon (Acipenser brevirostrum) (NMFS, 1998). My objectives will include: (1) Continued collection, processing (length/weight), and tagging of adult and juveniles; (2) Determining the abundance, age structure, and recruitment of sturgeon population segments; (3) Conducting mark-recapture, telemetry, survey sampling, etc. to document sturgeon seasonal distribution and mapping concentration areas to characterize essential habitat; and (4) Ensuring that actions authorized, funded, or conducted by federal or state agencies or private industry do not jeopardize the continued existence of sturgeon; (5) My objectives in analyzing tissues from sturgeon collected accidental mortalities, responds directly to recovery/research tasks where collections of sturgeon tissue, food items, and sediment/water samples from sturgeon habitat aid in assessing the degree of contaminant loading; (6) My study objectives are also related to determining the seasonal occurrence and distribution of juvenile sturgeon, which responds directly to NOAA Fisheries conservation recommendations in Biological Opinions for maintenance dredging and other activities

in the Delaware River and Estuary; (7) Sampling is also proposed to characterize Atlantic and shortnose sturgeon of various life stages occurring near industrial water intakes where entrainments/impingement is a potential threat; and (8) Testing the efficiency and accuracy of hydro-acoustic technology to identify and enumerate shortnose and Atlantic sturgeon in their natural environment.

Justification of Objectives:
Importantly, many of our objectives will provide managers the ability to better manage threats to the species in the Delaware River and Estuary from municipal and industrial activities such as discharges, water withdrawals, dredging operations and heavy shipping.

However, in order to study the current status of each species and how it is related to existing threats, our base objectives will include developing an updated population estimate for the shortnose sturgeon in the Delaware River by using multiple mark-recapture techniques. And, similarly for Atlantic sturgeon, we will characterize an annual juvenile recruitment index for the species, as well as document the occurrence of spawning and spawning periodicity.

Because it is important to be able to identify and protect crucial habitat for all sturgeon life stages, we will study juvenile populations of both species. To accomplish many of our goals in this regard, we will be implanting juvenile Atlantic and shortnose sturgeon with ultrasonic (acoustic) transmitters to actively and passively track these fish, monitoring the spatial and temporal patterns associated with early juvenile nursery areas, individual movement patterns, home ranges, foraging habitat, and over-wintering habitats. Longer-term monitoring of individuals will also be necessary to define changing nursery habitat over time as individual animals recruit into a new age class and also identifying when shifts become apparent in habitat preferences.

Furthermore, because of the documented threats of entrainment and impingement at cooling water intakes of specific industrial sites on the Delaware River, we will be conducting studies, designed in compliance with the EPA Clean Water Act 316b Rule, to characterize the aquatic biota which could potentially be subjected to entrainment (juvenile and early life stage aquatic organisms) and impingement (older juvenile, adult and sub-adult aquatic organisms) at these industrial intakes. Our research focus related to endangered shortnose and Atlantic sturgeon would be focused on documenting the proportions of shortnose and Atlantic sturgeon life stages sampled within these aquatic communities.

Further, we are also proposing to address specific threats to sturgeon by testing remote hydro-acoustic technology to identify Atlantic and shortnose sturgeon in a mixed-species environment. Because of the current dredging and development of port facilities in the Delaware River industrial complex, refinement of proven advanced remote hydro-acoustic technologies, such as side scan and Didson sonar, would assist researchers to remotely detect, identify, and image sturgeon near these industrial activities. If proven, these technologies will assist policy managers charged with assessing and mitigating the direct and indirect effects of blasting, dredging, monitoring water intake, and in-river disposal, for all life stages of sturgeon. Such techniques could also be exported to other drainages (e.g., the Potomac River and Chesapeake Bay) to perform similar remote sensing surveys for sturgeon in other watersheds where little is known about their occurrence and distribution. Moreover, if such technology is proven effective at locating and identifying sturgeon in a mixed environment, it would increase the efficiency of researchers in locating and capturing sturgeon, eliminating hours spent netting and trawling.

Description: ==========

*Action Area, Duration, and Sampling Sites
It is requested that the permit cover all research activities on Atlantic and shortnose sturgeon from the mouth of Delaware Bay at rkm 0 to 245. Sites to sample older life stages in the freshwater-brackish water interface will be selected based on the ability to use an active gear such as gill/trammel nets, drift nets, trawl nets, trap nets and beach seines (McCord et al. 2007, Hatin et al. 2007). Preferred sampling sites would typically be flat bottom sites, free of snags, away from heavy ship traffic, and out of the main channel in 3-16 meters of depth. Our sampling will occur year-round with up to two times weekly; but sampling periods would be determined by sampling methods and experimental design. Our activities with passive and active telemetry of tagged animals, will also guide us in selecting other sampling sites in the future. Early life stages on spawning grounds, and also at sites selected near industrial cooling water intakes, would be sampled with epi-benthic and plankton samplers, pump samplers, D-nets; egg matt samplers; and beach seines.

*Research Methods

*Description of Annual Shortnose Sturgeon Take:
We plan on annually capturing/recapturing a total of up to 420 adult/sub-adult (>450mm), and juvenile (< 450mm) shortnose sturgeon (Take table row 1). These would be weighed, measured to TL, examined for tags, marked with Passive Integrated Transponder (PIT) tags, and T-bar tags, tissue sampled (i.e., genetic fin clip), photographed, and released. We would also anesthetize (with MS-222 or EN) and surgically implant two sets of 30 adult/sub-adult and 30 juveniles (300 < 450mm TL) (Take table row 2 & 3) with acoustic transmitters. Another set of up to 20 adults (>550 mm TL) (Take table row 4) would be captured and tethered in a nylon sock for remote hydro-acoustic testing. Up to 500 early life stages (ELS) (Take table row 5) would be collected by artificial substrate, D-frame/ ichthyoplankton nets, epibenthic sled, pump sampler, or beach seine. We would also anticipate up to two incidental mortalities of shortnose sturgeon (of any life stage) annually, but no more than one adult would be taken during the five-year permit (Take table row 6).

*Description of Annual Atlantic Sturgeon Take:
Our objectives for Atlantic Sturgeon include capturing/recapturing up to 370 juvenile (<600mm TL) Atlantic sturgeon and then weighing, measuring, examining for tags, marking with PIT tags, and T-bar tags, genetic tissue sampling (i.e., fin clip), photographing and releasing (Take table row 1). We also request capturing 30 juvenile (300 < 600mm TL) Atlantic sturgeon, and, in addition to the above research activities, they would be anesthetized (with MS-222 or EN) and implanted surgically with acoustic transmitters and released (Take table row 2). We would also capture another set of 30 juvenile (300 < 600mm TL) Atlantic Sturgeon for gastric lavage (diet analysis) (Take table row 3). Another set of 50 adult/sub-adults (>600mm TL) would be captured/recaptured, measured, weighed, PIT/Floy tagged, and photographed (Take table rows 4). A remaining set of 20 adult/sub-adults (Take table row 5) would be tethered in a nylon sock for remote identification using hydro-acoustic gear before being released. Up to 500 ELS (Take table row 6) would be lethally collected by artificial substrate, D-frame/ ichthyoplankton net, epibenthic sled, pump sampler, or beach seine. Finally, we would anticipate up to two incidental mortalities of Atlantic sturgeon (of any life stage), but no more than one adult (>1,300mm TL) could be taken during the five-year permit (Take table row 7).

*Capture, Handling, and Tagging of Adults and Juveniles

*Methods of Capture
-–Sturgeon of both species would be collected using gear (bottom-set gill nets, trammel nets, drift gill nets, trawl nets; egg matts, D-frame/ ichthyoplankton net, epibenthic sled, or trap nets and pump sampler) described in this application and in "A Protocol for Use of Shortnose, Atlantic, Gulf, and Green Sturgeons" (Kahn and Mohead, 2010).

*Anchored Gill nets:-- Gill nets of 5 to 6 inch (12.7 - 15.2 cm) stretched mesh will be used to target shortnose and Atlantic sturgeon juveniles and sub-adults. Larger 6 to 10 inch gill nets (15.2cm - 25.4cm) would target sub-adult and adult Atlantic sturgeon. Gill nets of 1 to 5 inches (2.54cm – 12.7cm) stretched mesh will also be used to sample juvenile shortnose and Atlantic sturgeons. Nets would be 100 m in length and 1.8 m deep, although shorter shots of net may sometimes be used.

Anchored gillnets would be fished in water temperatures at the deepest depth sampled by the gear for the entire duration of deployment between 0°C and 28°C, and at dissolved oxygen concentrations of 4.0 mg/l or greater; however, at temperatures less than 7ºC, and above 27°C, research activities must be limited to non-invasive procedures only (i.e., PIT and T-bar tag, measure, weigh, photograph, and genetic tissue clip) (See Table 1 below).

Table 1: Summary of environmental conditions for anchored gillnetting.
Water Temperature (ºC) Minimum D.O. Level (mg/L) Maximum Net Deployment (hr)
0 < 10 4.0 10.0 hr (1, 2)
10 < 15 4.0 4.0 hr (2)
15 < 20 4.0 2.0 hr (3)
20 < 27 4.0 1.0

27 < 28 4.0 0.5
>28 N.A. Cease Netting
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1. Netting will occur between 0 and 10 ºC in sturgeon overwintering aggregation areas.
2. Nets will be checked at least every 2 hours.
3. Nets will be continually monitored when temperatures are above 15 ºC

Gill net sampling to mark and recapture shortnose sturgeon for population estimates will be performed in two distinct phases each year of study, targeting overwintering aggregations and dispersed sampling over a larger area during the summer-fall foraging period. Overwintering shortnose sturgeon will be sampled during November through March in the tidal Delaware River between Roebling and Trenton, NJ (~ rkm 186 to 215). It is anticipated that the overwintering areas will be sampled most intensively. Population size will be estimated using the Chapman modification of the Schnabel method (Ricker, 1975) or the Jolly-Seber multiple mark-recapture method. Dispersed-phase sampling for both Atlantic and shortnose sturgeon will be performed during May through October throughout the tidal Delaware River from Artificial Island, NJ to Trenton (rkm 79 to 215).

*Drift Netting: --Drift trammel nets will be used to target juvenile Atlantic sturgeon in the Marcus Hook area of the river south of Philadelphia. Nets will be set at slack tide perpendicular or diagonal to the tidal current and tended closely by ERC personnel until the onset of the next tide. Each set will be for 30 minutes to 2 hours before retrieved. Gill nets will have a predetermined maximum deployment time dictated by water temperature, and dissolved oxygen (Kahn & Mohead 2010). To maximize opportunity of catching sturgeon, nets will be configured to make contact with the bottom. They will have small mesh (6, 9 or 10 cm stretch mesh) on the bottom 2 meters of net, and they will be 92 meters in length (McCord et al. 2007). Flat locations, free of snags near the freshwater-brackish water interface, are preferred. Global Positioning System coordinates will be recorded for each net set. We expect a variety of size and age classes will be captured in these gill net sets including late stage juveniles and early stage juveniles, and possibly adults, but unlikely.

*Trammel Nets: - Trammel nets would typically consist of 2 to 4 inch (5.1cm to 10.2cm) mesh size for the inner panes, and 8 to 12 inches (20.3 - 30.5 cm) in the outer panels, although experimental trammel nets could possibly vary depending on the targeted animal. Netting material would consist of heavy multifilament nylon mesh instead of monofilament or light twine. Trammel nets would be fished in water depths comparable to gill nets, anchored on the bottom. Therefore, the same standardized netting protocol (duration, temperature and D.O.) as described above for gill nets would be followed for trammel nets when fished on the bottom.

Trammel nets targeting juveniles would typically be about 50 m long and 1.8 m deep, consisting of two outer panels of 24 inches (60.8 cm) stretched multifilament nylon mesh and an inner panel of 1 inch (2.5-cm) stretched multifilament nylon mesh.

*Trawling:- Trawling will sample juvenile Atlantic and shortnose sturgeon in the Delaware River. Dovel and Berggren (1983) found that small trawls were effective for such collecting in the Hudson River. Trawling for juvenile shortnose and Atlantic sturgeon will be performed in the tidal Delaware River from Artificial Island to Trenton (rkm 75-215) using a 4.9 m otter trawl and/or a 14.6 m Yankee trawl. Specifications for these trawl nets are provided below:

Trawl Type 4.9 m Otter Trawl or 14.6 m Yankee Trawl
Headrope (m) 5.2 14.6 m
Footrope (m) 6.4 21.0 m
Net body mesh (mm) 38 & 50 80 mm
Codend mesh (mm) 32 50 mm
Inner-liner mesh (mm) 13 & 5 14 mm

Trawl nets will be towed at a maximum speed of 5 miles per hour, typically between 10 to 15 minutes. Bottom areas where nets are to be sampled would be evaluated with sonar devices prior to

trawling to determine if substrate suitable and is free from snags. If a trawl net becomes snagged on bottom debris, it will be untangled immediately to reduce stress on the animals. To lessen benthic disturbances, trawl nets will not be towed over the same exact location more than once in a 24-hour period using a GPS system.

*Pound Nets and other Trapping Nets: -- Pound, and other trap nets opened to the surface, are proposed to fished in waters when sampling near the cooling water intakes of industrial plants. In general, such trapping gear is stationary fishing gear beginning with a length of netting called the "leader," stretching out perpendicular from the shoreline. The leader does not actively capture fish; instead, it spans the depth of the water column, diverting fish away from shore and into the trap (or pound) located offshore. These are typically linked together in chains and equipped with wings and leaders. The maximum duration such nets could be deployed without checking would be 24 hours.

*Beach Seines:-- Beach seines operated from the shore are proposed as a capture method for Atlantic and shortnose sturgeon in the Delaware River. This gear is proposed for targeting young of year or juvenile fish foraging along flat sandy areas of rivers and estuaries that are not able to out-swim the hauling action of the seine. In particular, this method is proposed as an effective method for sampling areas near cooling water intake structures of industrial plants; but would also be effective at documenting spawning activity. The seine is lengthened by long ropes for towing when encircling fish and drawing them to the beach. The seine therefore provides a barrier, preventing the fish from escaping from the area enclosed by a centered bag portion of the net when surrounded. The head-rope of the seine (~30 meters long) would be fitted with floats on the surface and the footrope would remain in permanent contact with the bottom weighted leaded line. When setting the seine, the first towing line is fastened ashore, and then the lead wing is set out in shallow water in a wide arc and brought back to the beach. The bottom and surface act as natural barriers preventing young fish from escaping from the enclosed area of the net. The drag lines would be towed simultaneously from the beach and the fish would be herded in front of the bag. When the ground ropes reach the beach first, the catch would be gathered in the bag by bringing the gear underneath the fish. The bycatch would be sorted and returned to the water and all sturgeon would be then be sized and weighed and, if appropriate PIT tagged.

*General sturgeon handling and processing:
All sturgeon will be handled and processed in accordance with "A Protocol for Use of Shortnose, Atlantic, Gulf, and Green Sturgeons" (Kahn and Mohead, 2010). Sturgeon will be measured (fork and total length), weighed, and tagged with a numbered Floy T-bar tag and a Passive Integrated Transponder (PIT) tag (see below). Fish will be supported in a moist nylon mesh bag during weighing. Handling during processing will be minimized and smooth rubber gloves will be worn to reduce abrasion of the skin. Photographs will be taken of selected animals.

*PIT Tagging: – PIT tags would be used to individually identify all captured fish not previously tagged. The entire dorsal surface of each fish would be scanned with a waterproof PIT tag reader and visually inspected to ensure detection of fish tagged in other studies. Previously PIT-tagged fish would not be retagged. We would insert 8 mm PIT tags in juvenile Atlantic or shortnose sturgeon measuring between 250 mm and 350 mm in total length. Larger sturgeon would receive 11.9 mm PIT tags. Prior to placement of PIT tags, the injection needle and site would be sanitized with a disinfectant such as isopropyl alcohol. PIT tags would be injected in the dorsal musculature just anterior to the dorsal fin with the copper antenna oriented up for maximum signal strength and scanned after implantation to ensure proper tag function.

*Floy/T-bar Tags: – A numbered Floy T-bar tag will be placed at the dorsal fin musculature base and inserted forwardly and slightly downward from the left side to the right through the dorsal pterygiophores of sturgeon (>300mm). After removing the injecting needle, the tag will be spun between the fingers and gently tugged to be certain it is locked in place. Tagging with T-bar tags in addition to a PIT tag is proposed to allow identification of the tagged fish by other recreational and other researchers in the action area, enabling collection of additional information useful for assessment of sturgeon population size and movements.

*Acoustic Tags: – In order to document habitat for shortnose and Atlantic sturgeon, both species will be surgically implanted with appropriately sized acoustic tags. A maximum of 30 adult and 30 juvenile shortnose sturgeon and 30 juvenile Atlantic sturgeon per calendar year will be surgically implanted with internal acoustic transmitters. The total weight of tags will not exceed 2 percent of the fish's body weight. Adult shortnose sturgeon will be tagged with VEMCO V16-5H or V13 acoustic tags. Juvenile shortnose and Atlantic sturgeon (>300 mm) will be tagged with VEMCO V7-4L or V9-6L, depending on the weight of the individual sturgeon. Specifications for these transmitters are as follows:

Model Length (mm) Diameter (mm) Weight in Water (g)
V7-4L 22.5mm x 7 1mm 1.8g

V9-6L... 21.0mm x 9 2mm 2.9g
V13-1H... 36.0mm x 13 6mm 11.0g
V16-5H.....95.0mm x 16 2mm 36.0g

Tag implantation will be performed in accordance with "A Protocol for Use of Shortnose, Atlantic, Gulf, and Green Sturgeons" (Kahn and Mohead, 2010). Only sturgeon in excellent condition will be selected for surgery. Each will be anesthetized using tricaine methanesulfonate (MS-222) (a dose of up to 150 mg/L) or electro-narcosis and then held upside down in a cradle where the gills will be perfused with aerated flowing water. The surgical site will be sanitized with povidone iodine (10 percent solution). A new scalpel will then be used with each surgery, making a small longitudinal abdominal incision. A transmitter would then be inserted into the body cavity and the incision would be closed with interrupted sutures of 3-0 polydioxanone (PDS) and treated with a Vaseline/povidone iodine mixture to prevent infection. Post-surgery, fish would be held in an aerated holding tank and released upon recovery from anesthesia. Based on the implantation of several hundred acoustic tags in sturgeon authorized in our prior permits, the surgical procedure requires approximately 5 minutes to complete, with a total holding time (anesthesia induction, surgery, and recovery) of 20 minutes or less. Surgical implantation of internal tags will not be performed when water temperatures exceed 27°C or are less than 7°C.

*Anesthesia with MS-222: – Fish selected for internal surgeries or gastric lavage will be anesthetized using MS-222 (using a dose of up to 150 mg/L). Animals will be observed carefully to assess full narcotic state in preparation for invasive procedures. Movement and equilibrium will be monitored throughout to determine the depth of anesthesia and to ensure the condition of the animal. Upon completion of the surgery or lavage procedure, the fish will be returned to fresh water in either the live well of the boat or a boat-side net pen in and assisted with ventilation by slowly moving the fish back and forth in the water while gently supporting it by the tail and under the body. We are fully experienced in use of MS-222 for anesthetizing sturgeon.

*Anesthesia with Electro-narcosis (EN):--Using the method of EN described by Henyey et al. (2002), we would use non-pulsed DC voltage (0.3-0.5 V/cm, 0.01 amp) when anesthetizing animals. In this procedure, fish would be placed in a tank having an anode screen at one end of the tank and a cathode screen at the other end. Amperage would be minimized throughout the procedure. As voltage is applied quickly to the anode (1-2 sec), the subject fish would lose equilibrium and relax, sinking to the bottom. Voltage would then be adjusted downward until the fish becomes immobilized except for strong opercula movement. Fish would then be supported with netting sling so only their back or ventral surface is emerged from the water before work is conducted. All Co-investigators authorized in our permit will receive supervision and experience in the use of EN prior to anesthetizing sturgeon with EN prior to using it.

*Gastric Lavage (Atlantic Sturgeon diet study): --Stomach contents of selected 30 juvenile (300mm < 600mm) Atlantic Sturgeon annually would be sampled for diet analysis throughout the spring, summer, fall and winter using gastric lavage (Haley, 1998; Collins et al., 2008). Fish selected for gastric lavage would be anesthetized using 50 to 100 mg/L of MS-222 or EN to relax the fish prior to the procedure. Using a flexible polyethylene tube having a 2mm outer diameter, we would pass the tube carefully through the sturgeon's alimentary canal and verified to be properly positioned in the stomach by feeling the tubing from fish's ventral surface. Gastric lavage would be then be carried out by gently flooding the stomach cavity with water delivered from a pressurized garden sprayer. The fish would then be allowed to recover in aerated holding tanks or floating net pens prior to release. The entire procedure, including anesthetizing, would take from three to eleven minutes (Collins et al., 2008). No other invasive procedure would be performed on fish undergoing gastric lavage.

*Hydro-acoustic Testing:-– Twenty shortnose sturgeon adults (>550mm TL) and 20 Atlantic sturgeon adults or sub-adults (>600mm TL) would be scanned using fishery hydro-acoustic and/or sonar equipment as part of an evaluation of technologies for remote detection and identification of sturgeon (Brundage and Jung, 2009; Nealson and Brundage, 2007). Sturgeon tested with hydro-acoustic/sonar would be scanned while still in nets or while tethered using soft fabric mesh sleeves for periods not exceeding two hours when water temperature and D.O. concentration are below 20 OC and above 4.0 mg/L respectively.

Methods proposed will follow Brundage and Jung (2009) where sturgeon and three other non-listed fish species for hydro-acoustic data collection were captured using anchored bottom-set gill nets. Hydro-acoustic measurements were first collected by passing over the netted fish with a downward looking broadband sonar transducer. Following acoustic data collection, the netted fish were recovered, identified, and measured for total length. In the present study, however, data would typically be collected over a frequency range of 110-220 kHz, using a pulse length of 1 meter and an acoustic pulse repetition rate of 3 pings per second. The current proposal also includes alternate collections of data at ping rates higher than that used in previous the investigation, using both broadband and narrowband sonar at ping rates of +30 pings per second and alternating between broadband single-beam and narrowband split-beam signals. Narrowband split-beam processing allows locating a target with an accurate bearing angle, and the broadband spectrum can be adjusted according to transducer sensitivity and the beam plot across the band. For that

reason, it is also proposed to collect data from fish tethered in a specially designed frame (or sock) where the aspect angles can be controlled, getting better detail and specification, similar to that used by Jung et al. (2004) with salmon smolts.

*Temporary Holding Procedures – Sturgeon will be held in a flow-through holding tanks or boat-side net pens Holding tank would allow for total replacement of water volume every 15-20 minutes and aerated as necessary during periods of high temperature and/or low dissolved oxygen to ensure dissolved oxygen concentrations do not fall below 5 mg/L. An electrolyte will be added to the water in the holding tank. Total holding time of any one sturgeon would not exceed two hours and processing time of any one sturgeon would not exceed 15 minutes, not including recovery time from anesthesia in the live car or holding tank. Fish receiving surgically-implanted transmitters would be held only until the fish has recovered from the anesthesia and surgery.

*Tissue Sampling for Genetic Analysis --An approximate 1-cm2 piece of soft fin tissue for genetic analysis would be collected from the trailing margin of a pelvic fin or the caudal fin of sturgeon. The tissue sample would be removed using sanitized scissors and preserved in 95 percent ethanol and shipped to the appropriate location for archival as directed by NMFS.

*Documenting Spawning Occurrence and Periodicity: –The positions and early spring movements of previously telemetered sturgeon would be monitored to document spawning runs (i.e., locate spawning areas and document the spawning activity) at various locations in the river. Positions of tagged fish would be identified and recorded using portable GPS units, after which, measures of key habitat attributes (water temperature, depth, current velocity, substrate, etc.) would be obtained. Once spawning activity is suspected, sampling devices would be deployed just downstream of the spawning activity. Egg density, distribution, and spawning periodicity would be closely monitored throughout the spawning seasons so that annual egg deposition can be estimated for all major spawning areas.

*Collection of Eggs and Larvae (ELS):
--Annual sampling for 500 shortnose sturgeon and 500 Atlantic sturgeon ELS will be performed in the lower non-tidal Delaware River in spawning areas, and also in locations near cooling water intakes of selected industrial sites. An attempt will be made to examine egg and larvae samples, returning any ELS to a suitable area or substrate for maturation. Samples of ELS captured at plant intakes would be preserved with a 10% aqueous formalin solution stored for laboratory processing to make positive species identifications. All ELS sampled, however, as noted previously, will be accounted as lethal directed takes.

*ELS Sampling Gear and Methods: – Sampling for sturgeon ELS will be with artificial substrates (pads), D-frame ichthyoplankton nets, an epibenthic sleds, pump samplers, or beach seines. The artificial substrates will be used in spawning areas consisting of floor buffing pads (McCabe and Beckman, 1990) anchored to the river bottom using concrete pavers and marked with a float. The artificial substrates will be deployed in a stratified fashion downstream of spawning activity to cover habitats likely to support settling of early life stages. Each will be examined in the field for sturgeon eggs or larvae, photographed, and immediately returned to the river.

*The D-frame nets will consist of framed nets 76 cm across the base and 54 cm high, and will be fitted with a knotless 1600 µm mesh nylon bag 317.5 cm long with a detachable cod end. The passive ichthyoplankton nets will be set on the bottom, for durations of approximately 1-3 hours, within and downstream of probable spawning locations (Taubert, 1980; Auer and Baker, 2002). A towed epibenthic sled would be fitted with an ichthyoplankton net similar to the net described above may also be used if locations suitable for deployment of such gear are identified. The ichthyoplankton nets will be equipped with a flow meter to measure volume of water filtered.

*Pump sampling would be used to sample ELS in front of, or within power plant cooling water intake systems, drawing water and ichythoplankton samples from near the river bottom through plankton net located at the surface. The pump system consists of a centrifugal pump and a 0.5 mm ichthyoplankton net set in a large cylindrical plastic tank. Water is pumped from the water body, via a suction hose, and filtered through the plankton net and measured with an in-line flowmeter. Approximately 50-250 m3 of water would be filtered per sample.

Incidental Mortality or Serious Harm
Because we anticipate working at a more rigorous pace during the next five years, capturing and processing up to 500 each of Atlantic and shortnose sturgeon annually, we anticipate some incidental mortalities may occur as a result of the effort. Therefore, we are requesting two unintended mortalities or serious harm for each species resulting from our research activities, but no

more than one Atlantic or shortnose sturgeon adult is requested over the life of the permit. Historically, unintentional mortality of sturgeon taken under previous permits were recorded as follows in annual reports of Permit No. 1174 (7 SNS in 5 years; or 0.22% of 3,286 fish captured); Permit No. 1486 (0 SNS in 5 years); and Permit No. 14604 (1 SNS in 5 years; or 0.34% of 294 fish taken). In current Permit No. 16438, we recorded one Atlantic sturgeon mortality in three years, or 1.5% of 66 taken.

*Non-targeted Bycatch:
--Other non-target species collected with gill nets, trammel nets, trawls, traps, seines; epibenthic nets, trawls or pump samplers could include multiple life stages of blueback herring (Alosa aestivalis), alewife (Alosa pseudoharengus), American shad (Alosa sapidissima), Atlantic menhaden (Brevoortia tyrannus), striped bass (Morone saxatilus), white perch (Morone americana), channel catfish (Ictalurus punctatus), and white catfish (Ameiurus catus). Non-target fish would be removed from the net and released at the site of capture. It is also likely that small numbers of non-target ELS spawning in the spring would be collected with sampling gear when sampling for shortnose and Atlantic sturgeon ELS. These species may include river herring (Alosa spp.), American shad (Alosa sapidissima), quillback (Carpiodes cyprinus), and various minnows (Cyprinidae). Due to the nature and scope of the proposed sampling, it is not anticipated that the incidental collection of any non-target fish species will negatively impact their populations in the Delaware River and Estuary. None of the non-target fish species that may be collected during the proposed research are currently listed under the ESA.

*Listed Sea Turtle Species:
-- I have been conducting fisheries field work on the Delaware River, including extensive gill netting and trawling, for over 35 years, and I have never captured a sea turtle using standard gill netting or trawling practices in the river locations where I have fished. However, in terms of interactions with sea turtles in the lower Delaware Bay, on rare occasion, they have been taken on the trash racks at the Salem Generating Station (rkm 79). However, I am not aware of sea turtles being taken at any other power plants upstream location on the lower Delaware River, including those at Delaware City (approx. rkm 90), Edgemoor (approx. rkm 121), or Eddystone (approx. rkm 138). The available information suggests the occurrence of sea turtles upstream of rkm 79 is very rare and I believe that the probability of our encountering one during our normal netting above this location is extremely unlikely with the measures we employ.

However, because listed sea turtles have been known to occur as transients in the lower Delaware River (< rkm 79), occupying the mouth of the Delaware Bay and further upstream locations during the summer months-- and because we will be fishing in this area--when sampling near cool water intakes of industrial plants--it is possible loggerhead turtles (Caretta caretta; ESA threatened) or Kemp's ridley turtles (Lepidochelys kempii; ESA endangered) or green sea turtles (Chelonia mydas; ESA endangered) could interact with some of our gear below rkm 79. However, although we do not anticipate harming sea turtles, we do expect to catch up to two turtles annually of any species, typically juveniles. The gear used for sampling near the cool water intakes of selected industrial plants, would include trap nets (open to the surface), beach seines, pump samplers, epibenthic trawls, small otter trawls, small mesh gill nets (3-5 inch), each not expected to harm turtles. When using larger mesh gill/trammel nets below rkm 79, we would be drift fishing and employing continuous monitoring of nets, which would limit potential mortality or harm to turtles.

*Marine Mammals
Similarly, marine mammals, such as a harbor seals or bottle nose dolphins, are sometimes transient in the lower Delaware River. However, we do not anticipate capturing or harming a marine mammal in our research. However, should we encounter a marine mammal in our activities, we would immediately follow all permit measures designed to avoid interaction.

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Supplemental Information

Status of Species:

(1) Shortnose sturgeon: The population of shortnose sturgeon in the Delaware River and Estuary is substantial and appears to be stable. Using mark-recapture data collected during January 1999 through March 2003, ERC (2006) calculated a modified Schnabel estimate of 12,047 adult shortnose sturgeon in the Delaware River, with a 95% confidence interval of 10,757-13,589. Using data collected during 1981-1984, Hastings et al. (1987) calculated a modified Schnabel estimate of 12,796 adult shortnose sturgeon, with a 95% confidence interval of 10,288-16,367. These estimates, roughly 20 years apart, are nearly identical and indicate that the adult shortnose sturgeon population in the Delaware River is stable.(For a more complete discussion of the status of the species for shortnose sturgeon, see Shortnose Sturgeon Status Review Team. 2010. A Biological Assessment of shortnose sturgeon (Acipenser brevirostrum). Report to National Marine Fisheries Service, Northeast Regional Office. November 1, 2010. 417 pp.

(2) Atlantic sturgeon, New York Bight DPS (plus other mixed DPS stock)
ESA endangered; CITES Appendix II – Five DPSs of Atlantic sturgeon have been listed under the ESA. The Gulf of Maine DPS was listed as threatened while the New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs were listed as endangered. There is currently no reliable estimate of the size of the Atlantic sturgeon population in the Delaware River. (For a more complete discussion of the status of Atlantic sturgeon, see listing documents in the Federal Register at: 77 FR 5914; and 77 FR 5880).
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Lethal Take:

Directed lethal take is requested for ELS of Atlantic and shortnose sturgeon. ELS mortality is unavoidable due to collection methods used and the preservation of some or all of the ichthyoplankton net samples for laboratory processing. We request 500 shortnose sturgeon and 500 Atlantic sturgeon ELS per calendar year since our sampling design calls for intensive early life stage sampling to define spawning areas, and also to document entrainment of larvae at industrial plants.

Moreover, we anticipate two unintended mortalities or serious harm annually for both sturgeon species resulting from research activities; but no more than one sturgeon adult of each species is requested over the life of the permit.

Anticipated Effects on Animals:

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The risks to Atlantic and shortnose sturgeon by this project would typically occur in several discrete activities involving: capture, handling, marking, anesthesia and surgery. This section addresses the specific risks of each of these activities to both species.

*Capture: Capturing Atlantic and shortnose sturgeon in gillnets and trammel nets can result in injury and mortality, reduced fecundity, and delayed or aborted spawning migrations of sturgeon (Moser and Ross 1995, Collins et al. 2000, Moser et al. 2000; and Kahn and Mohead 2010). Historically, the major cause of mortality, though, has been reported due to the occlusion of gills when trapped in nets. However, sturgeon mortality during scientific research is also related to capture as a function of numerous factors including water temperature, low dissolved oxygen concentration, soak time, mesh size, net composition, and netting experience.

*Handling/Restraint:
--Routine handling/holding can result in raised levels of stressor in shortnose and Atlantic sturgeon, which are hardy species and generally tolerant of handling. Nevertheless, they are sensitive to handling stress when water temperatures are high or dissolved oxygen concentration is low or they have been held for long periods of time. Additionally, sturgeons tend to inflate their swim bladder when stressed or handled in air (Moser et al. 2000). If not returned to neutral buoyancy prior to release, they tend to float and would be susceptible to sunburn and bird attacks.

*Marking/Tagging:
--Insertion of PIT and Floy/T-bar tags may impose cumulative handling stress on sturgeon, and tag insertion sites may also rarely become infected. When PIT tags are inserted into animals having large body sizes relative to the size of the tag, empirical studies have generally demonstrated that the tags have no adverse effect on the growth, survival, reproductive success, or behavior of individual animals. However, some fish, particularly juvenile fish, could be affected if PIT tag insertion if the tag penetrates too deeply.

*Surgical Implanting of Acoustic Tags:
--The surgical implantation of acoustic transmitters does have the potential to injure or kill Atlantic and shortnose sturgeon. In general, direct effects of the proposed tagging procedure could include pain, handling discomfort, hemorrhage at the site of incision, and risk of infection from surgery. Delayed problems could include breakage of sutures, infection, affected swimming ability, and/or abandonment of spawning runs.

*Anesthetizing Using MS-222:
--Risks associated with anesthetizing with MS-222 would include hypoxia from overexposure (typically caused by inexperience at recognizing the proper level of narcosis) (Coyle et al. 2004), anesthetizing fish in poor health or stressed conditions, and from thrashing during the excited phase of anesthetic induction.

*Risks Associated with the use of EN for Anesthesia:
-- The risks associated with the use of EN are minimal with experienced researchers using the correct current and understanding normal reactions of anesthetized animals when under EN. Application of an improper current (use of pulsed direct current (PDC), alternating current (AC), or using increased amperage or voltage with straight direct current (SDC) can cause substantial internal bleeding (hematoma), seizure, or tetany. However, Henyey et al., (2002) report that normal respiration occurs and minimal discomfort when proper current levels of SDC are adjusted to the point where fish maintain a relaxed state and strong opercula movement. When used correctly (Kahn and Mohead 2010) the impacts of EN are equal to the relaxed condition induced by chemical anesthetics and also in terms of stress hormones produced. Balazik et. al. (2013) supports this claim, finding that cortisol concentrations measured one hour after animals were treated with no anesthesia, were almost two times greater than concentrations measured for either electronarcosis or MS222, each of which had similar cortisol concentrations. However, after 24 hours, cortisol levels for controls and both treatment animals were the same. The benefits of using EN are that: (1) there is no pain experienced by animals when anesthesia is induced by EN; (2) narcosis induction and recovery times are minimal (within seconds, after the current is applied or removed); and (3) there are no chemicals ingested by animals.

*Gastric Lavage (Atlantic Sturgeon only):
Potential injury to sturgeon could include abrasion of the gut wall near the pyloric caecum, trauma associated with not seating the tubing properly, and potential negative growth responses of sturgeon (going off-feed) after lavaging.

*Genetic tissue sampling:

--Tissue samples, clipped with sterile surgical scissors from sections of soft tissue fin rays of captured sturgeon, do not appear to impair the sturgeon's ability to swim and is not thought to have any long-term adverse impact (Wydoski and Emery 1983).

*Collection of Eggs and Larvae: - Takes of shortnose or Atlantic sturgeon eggs and larvae collected will be accounted for as killed during collection or preservation, although we recognize many will survive after returned to appropriate bottom substrate. However, we do not feel the proposed collection of sturgeon eggs and larvae will have a deminimus effect on the populations or shortnose or Atlantic sturgeon in the Delaware River. Based on the fecundity reported by Dadswell (1979) for shortnose sturgeon and the total population of shortnose sturgeon estimated in Delaware River, a take of 500 eggs represents only <0.5% of the potential egg production by one average female. Life-stage specific survival rates have not been accurately determined for either sturgeon species, but we do not think impacts of this proposed take of ELS is detrimental to the ability of the species to survive.

*Unintentional Mortality: Since we anticipate working at a much rigorous pace in our proposed permit, capturing and processing 5,000 Atlantic and shortnose sturgeon over five years, we anticipate that unintentional mortalities may occur as a result. However, based on our prior research, we anticipate only a small number of animals may be harmed or killed. Accordingly, we have requested two unintentional mortalities per calendar year for each species, with no more than one Atlantic or shortnose sturgeon adult killed over the five years of study. However, based on the latest population estimates for shortnose sturgeon and the improved production of Atlantic sturgeon juvenile cohorts in the Delaware River, it is anticipated that our research activities will have little significant impact on the sturgeon populations.

Measures to Minimize Effects:

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*Capture: - Several methods will be implemented to minimize the stress and pain of sturgeon captured in gill nets, drift nets, trawls, plankton nets etc. Overall sampling time, net set duration as well as handling time will be reduced when water temperatures are greater than 27º C since higher water temperatures have been found to be stressful for Atlantic and shortnose sturgeon (Moser et al. 2000 and Kahn Mohead 2010). Periods of high temperatures and low dissolved oxygen have occurred in the past during the summer and fall sampling seasons in areas proposed in this study. Consequently, water quality will be watched closely and sampling will not occur during periods of low dissolved oxygen or high temperatures. If sturgeon are entangled in nets and gills are occluded, we will cut meshes to expedite their removal from the net. Further, if water quality causes sturgeon to become lethargic during sampling, for no apparent external reasons, sampling would cease as soon as possible, and any currently captured sturgeon would only be measured, weighed, photographed, PIT tagged, and genetic tissue sampled before it is recovered and released.

The shorter soak times we use while drift netting (30 minutes to 2 hours depending on tides), typically results in reduced pressure on the driftnets and less injury, stress and/or mortality experienced by captured fish. Also, because we will continually monitor drift nets at short intervals, sturgeon or non-target animals would be removed quickly from the nets, resulting in animals less likely to experience stress. Further, our closely tending of drift nets would also reduce the risk of gear entanglement or gear loss resulting in ghost nets.

Trawl nets will be towed at maximum speed of 5 miles per hour for 10 to 15 minutes. The bottom areas where nets are planned to sample would be evaluated with sonar systems prior to trawling to determine if substrate suitable and is free from snags. If a trawl net becomes snagged on bottom substrate, debris, etc. it will be untangled immediately to reduce stress on the animals. To lessen benthic disturbances, trawl nets will not be towed over the same exact location more than once in a 24-hour period using our sonar and GPS system.

As stated we will attempt to minimize capture impacts on non-target protected animals, such as sea turtles and marine mammals during our studies, by abiding by all permit conditions and minimizing trawling durations. In the lower river (< rkm 79), we will practice continual monitoring of our nets, limiting sampling to locations near intakes of industrial sites where our sampling methods would be more calculated and gear selective for target species. We would also attempt to eliminate interactions with marine mammals by our strict abidance to permit conditions which limit our approach to them or continuing netting when animals are detected within the immediate area.

*Handling/Restraint:--Handling stress will be minimized by minimizing holding and handling time, particularly during periods of high water temperature and low dissolved oxygen

concentration, wearing smooth rubber gloves during handling, and adding an electrolyte to water in the holding tank. Fish will be taken from the net and placed in live car, quickly measured, weighed, tagged and immediately returned to the water as soon as possible. Fish will be weighed, measured and tagged in a table frame supporting the length of the fish. Fish will not be held for more than two hours in the live car and will typically be held in a holding net for less than 30 minutes.

*Genetic Tissue Sampling:--As stated, a small (1.0 cm2) tissue sample would be collected from the trailing margins of soft fin tissue (pectoral or dorsal fins) using sharp sanitized scissors. To minimize any impact of sampling tissue for genetic tissue samples, care would be used when collecting. Instruments would be changed or disinfected and gloves changed between each fish sampled to avoid possible disease transmission or cross contamination of genetic material. Tissue preservation and archival will conform to permit conditions.

*PIT Tagging/T-bar Tagging: --PIT tags are used for permanently marking and identifying individual captured fish are biologically inert and have been shown not to cause problems associated with some other methods of tagging fish, such as scarring and tissue damage or otherwise adversely affecting growth or survival (Brännäs et al. 1994). However, since smaller juvenile sturgeon are more difficult to properly PIT tag, and thus more susceptible to harming as a result of this procedure (Henne et al. 2008), we would only be using 8mm PIT tags on all smaller sturgeon, while tags of 11.9 mm would be used on sturgeon above 350 mm (TL). Also we would not tag animals smaller than 300mm with Floy/T-bar tags.

*Implanting Acoustic Tags & Surgery: --Invasive tools used during the tagging process will be sanitized with isopropyl alcohol between uses on each fish. The incision area would also be swabbed with a disinfectant prior to making the incision. After surgery, povidone iodine will be spread over the area to deter bacteria from entering the wound. Further, surgery to implant transmitters will only be attempted when fish are in excellent condition, and only if the water temperature exceeds 27° C (to reduce handling stress) or is less than 7° C (due to slow rate healing of in low temperatures). We will also follow the rule of not exceeding a combined weight of the acoustic tags greater than 2% of the fishes' weight. Only animals larger than 300 mm TL will be telemetry tagged. Only experienced researchers will be permitted to perform telemetry tagging surgery on sturgeon.

*Minimizing Risks from MS-222 and EN as an Anesthetic:--To reduce risks from using MS-222, only properly trained staff would be permitted to anesthetize animals; and only non-stressed animals in good health would be anesthetized. To avoid injury while being anesthetized, sturgeon would be restrained with netting to prevent animals from jumping or falling out the anesthetic bath. Fish would be monitored closely during induction to reach the proper level of anesthesia prior to surgery, and would be observed to ensure proper recovery from anesthetic narcosis prior to release. Also, because MS-222 is an acidifying solution, potentially extending the induction time for narcosis, bath solutions would be buffered to a neutral pH with sodium bicarbonate and oxygenated prior to use. Similarly, to reduce risks from using EN, only properly trained staff would be permitted to use this technique, and only non-stressed animals in good health would be anesthetized with EN.

*Minimizing Impacts of Gastric Lavage:--To relax the sturgeon during gastric lavage, we will properly anesthetize animals with either light doses of MS-222 or use EN prior to using gastric lavage. Due to the morphology of the gut tract and position of the swim bladder in sturgeon, we will use care to not injure sturgeon while inserting the lavage tube into the esophagus while positioning it within the gut. Only properly trained staff would use this technique, and only non-stressed animals in good health would be gastric lavaged.

*Minimizing negative effects on Sea Turtles or Marine Mammals: - There is potential to capture sea turtles when sampling below rkm 79 in the Delaware River to characterize entrainment/impingement potential near cool water intake of industrial plants. However, it is unlikely any sea turtle caught in our capture gear, including trap nets (open to the surface), beach seines, epibenthic trawls, small otter trawls, and small mesh gill nets (3-5 inch), would be harmed. Further, because (1) the low speed that our trawls would be towed (maximum 5 miles per hour) for short durations (maximum 10 to 15 minutes); (2) the nature of our traps used in sampling would only confine animals in the traps open to the surface; and (3) larger gill nets or trammel nets used would be deployed as drift nets (below rkm 79) and would continually monitored at a minimum of 30 minute intervals or immediately when there is activity in the nets, we would not anticipate harming any captured turtle. Further, we would also abide by all other permit measures designed to avoid harming sea turtles. Should we capture a sea turtle, we would attempt to immediately release it unharmed.

Also to avoid interaction with any occasional, transient marine mammal, I plan to limit work gill netting or use of any other gear potentially injurious to marine mammals, to daylight sets only; and further we would not deploy nets when animals are observed within the vicinity of the research. Animals would be allowed to either leave or pass through the area safely before net setting is initiated. Additionally, in all boating activities, including travel to acoustic receiver arrays outside of the netting area, we would keep a close watch for marine

mammals to avoid harassment or interaction.
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Resources Needed to Accomplish Objectives: The proposed research will be funded by the National Marine Fisheries Service and the U.S. Army Corps of Engineers, and grants obtained through the Section 6 Cooperative Grant program.
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Disposition of Tissues: Collection of genetic samples (fin clips) will be coordinated with Tim King (Permit No. 17557, or as amended).

The handling and analysis of blood samples will be perfprmed by Barbara Hudson (Antech Diagnostics, Lake Success, NY)
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Public Availability of Product/Publications: The results of our research on shortnose sturgeon will be presented in project reports and, if warranted, in presentations at scientific meetings and journal publications.
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Location/Take Information

Location

Research Area: Atlantic Ocean **States:** DE,NJ **Stream Name:** Delaware River and Estuary **Begin Mile:** **End Mile:** 245.0
Location Description: Delaware River and Estuary; Mouth of Delaware Bay (River kilometer 0 to 245) in state borders of Delaware, Pennsylvania, and New Jersey. Further tracking of sturgeon on "runs" upriver are authorized should evidence indicate.

Take Information

Line	Ver	Species	Listing Unit/Stock	Production /Origin	Life Stage	Sex	Expected Take	Takes Per Animal	Take Action	Observe /Collect Method	Procedure	Transport Record	Begin Date	End Date
1		Sturgeon, shortnose	Range-wide (NMFS Endangered)	Wild	All	Male and Female	420	1	Capture/Handle/Release	Net, Gill	Mark, Floy T-bar; Mark, PIT tag; Measure; Photograph/Video; Sample, fin clip; Weigh	N/A	3/26/2015	4/19/2020
		Details: Capture/Recapture Population Estimate: Collection may be by gill/trammel net, trap, or trawl & seines												
2		Sturgeon, shortnose	Range-wide (NMFS Endangered)	Wild	Adult	Male and Female	30	1	Capture/Handle/Release	Net, Gill	Anesthetize; Instrument, internal (e.g., VHF, sonic); Mark, Floy T-bar; Mark, PIT tag; Measure; Photograph/Video; Sample, fin clip; Weigh	N/A	3/26/2015	4/19/2020
		Details: Acoustic Tagging Adults: Collection may be by gill/trammel net, trawl, trap or seine; The method for anesthesia will be either MS-222 or electro-narcosis.												

3		Sturgeon, shortnose	Range-wide (NMFS Endangered)	Wild	Juvenile	Male and Female	30	1	Capture/Handle/Release	Net, Gill	Anesthetize; Instrument, internal (e.g., VHF, sonic); Mark, Floy T-bar; Mark, PIT tag; Measure; Photograph/Video; Sample, fin clip; Weigh	N/A	3/26/2015	4/19/2020
		Details: Acoustic Tagging Juveniles: Collection may also be by gill/trammel net, trawl, trap, or seines; The method for anesthesia will be either MS-222 or electro-narcosis.											
4		Sturgeon, shortnose	Range-wide (NMFS Endangered)	Wild	Adult	Male and Female	20	1	Capture/Handle/Release	Net, Gill	Mark, Floy T-bar; Mark, PIT tag; Measure; Other; Photograph/Video; Sample, fin clip; Weigh	N/A	3/26/2015	4/19/2020
		Details: Other = remotely sensed with hydroacoustic equipment.											
5		Sturgeon, shortnose	Range-wide (NMFS Endangered)	Wild	Adult/ Juvenile	Male and Female	2	1	Unintentional mortality	Net, Gill	Unintentional mortality	N/A	3/26/2015	4/19/2020
		Details: Unintentional mortality or serious harm of 1 shortnose sturgeon; but no more than 1 adults the five year permit.											
6		Sturgeon, shortnose	Range-wide (NMFS Endangered)	Wild	Egg/ Larvae	Unknown	500	1	Intentional (Directed) Mortality	Net, D-frame	Collect eggs; Intentional (directed) mortality	N/A	3/26/2015	4/19/2020
		Details: An annual take of 500 eggs/larvae; collection may be by seines, artificial substrate, epibenthic sleds, D-nets, or pump sampler											
7		Sturgeon, Atlantic	Range-wide (NMFS Endangered/Threatened)	Wild	Juvenile	Male and Female	370	2	Capture/Handle/Release	Net, Gill	Mark, Floy T-bar; Mark, PIT tag; Measure; Photograph/Video; Sample, fin clip; Weigh	N/A	3/26/2015	4/19/2020
		Details: Capture/Recapture Juvenile Population of ATS: Collection may also be by trammel net, trap, trawl & seines											
8		Sturgeon, Atlantic	Range-wide (NMFS Endangered/Threatened)	Wild	Juvenile	Male and Female	30	1	Capture/Handle/Release	Net, Gill	Anesthetize; Instrument, internal (e.g., VHF, sonic); Mark, Floy T-bar; Mark, PIT tag; Measure; Photograph/Video; Sample, fin clip; Weigh	N/A	3/26/2015	4/19/2020
		Details: Accoustic Tagging Juveniles: Collection may also be by trammel net, trap, trawl, & seines											
9		Sturgeon, Atlantic	Range-wide (NMFS Endangered/Threatened)	Wild	Juvenile	Male and Female	30	1	Capture/Handle/Release	Net, Gill	Anesthetize; Lavage; Mark, Floy T-bar; Mark, PIT tag; Measure; Photograph/Video; Sample, fin clip; Weigh	N/A	3/26/2015	4/19/2020
		Details: Diet Study (Gastric Lavage of Juveniles)											

10		Sturgeon, Atlantic	Range-wide (NMFS Endangered/Threatened)	Wild	Adult	Male and Female	50	1	Capture/Handle/Release	Net, Gill	Mark, Floy T-bar; Mark, PIT tag; Measure; Photograph/Video; Sample, fin clip; Weigh	N/A	3/26/2015	4/19/2020
		Details: Capture Adults and Sub-adults (>600mm): These will be the pool of excess of adult/sub-adults in order to select animals for hydro-acoustic testing in Line No. 11, below.												
11		Sturgeon, Atlantic	Range-wide (NMFS Endangered/Threatened)	Wild	Adult	Male and Female	20	1	Capture/Handle/Release	Net, Gill	Mark, Floy T-bar; Mark, PIT tag; Measure; Other; Photograph/Video; Sample, fin clip; Weigh	N/A	3/26/2015	4/19/2020
		Details: Other = Adult/Sub-adults selected to remotely sensed with hydroacoustic equipment.												
13		Sturgeon, Atlantic	Range-wide (NMFS Endangered/Threatened)	Wild	All	Male and Female	2	1	Unintentional mortality	Net, Gill	Unintentional mortality	N/A	3/26/2015	4/19/2020
		Details: Unintentional Mortality: or serious harm of 1 Atlantic sturgeon; but no more than 1 adult over the five year permit.												
14		Sturgeon, Atlantic	Range-wide (NMFS Endangered/Threatened)	Wild	Egg/ Larvae	Unknown	500	1	Intentional (Directed) Mortality	Net, D-frame	Collect eggs; Intentional (directed) mortality	N/A	3/26/2015	4/19/2020
		Details: An annual take of 500 eggs/larvae; collection may be by seines, artificial substrate, epibenthic sleds, D-nets, or pump sampler												

NEPA Checklist

1) If your activities will involve equipment (e.g., scientific instruments) or techniques that are new, untested,or otherwise have unknown or uncertain impacts on the biological or physical environment , please discuss the degree to which they are likely to be adopted by others for similar activities or applied more broadly.

The proposed research will utilize previously developed and validated techniques as recommended by NMFS in Kahn and Mohead (2010). We are adding electro-narcosis to our permit for the first time for the purposes of inducing anesthesia in surgical and laparoscopic procedures, as a less stressful method for anesthesia (Kahn and Mohead 2010). However, before a researcher on our permit attempts to anesthetize a shortnose sturgeon use electro-narcosis, he/she must have first received supervised training on shortnose sturgeon, or other surrogate species, before doing so.

2) If your activities involve collecting, handling, or transporting potentially infectious agents or pathogens (e.g., biological specimens such as live animals or blood), or using or transporting hazardous substances (e.g., toxic chemicals), provide a description of the protocols you will use to ensure public health and human safety are not adversely affected, such as by spread of zoonotic diseases or contamination of food or water supplies.

Genetic tissue samples will be collected from shortnose and Atlantic sturgeon that are shipped to a laboratory for analysis in vials of ETOH. These samples will be properly packaged, and shipped via a courier specializing in shipment of biological materials (i.e., samples meeting DOT stands of shipping ETOH by air transport).

Toxic Chemicals. Some ichthyoplankton samples will be returned to the laboratory for processing. These samples will be transported/stored in plastic containers and preserved in 10% neutral-buffered formalin. Shortnose sturgeon eggs and larvae will be removed from the attendant detritus in the sample and preserved in 90% ethel alcohol. Waste formalin will be disposed through an approved waste hauler.

3) Describe the physical characteristics of your project location, including whether you will be working in or near unique geographic areas such as state or National Marine Sanctuaries, Marine Protected Areas, Parks or Wilderness Areas, Wildlife Refuges, Wild and Scenic Rivers, designated Critical Habitat for endangered or threatened species,

Essential Fish Habitat, etc. Discuss how your activities could impact the physical environment, such as by direct alteration of substrate during use of bottom trawls, setting nets, anchoring vessels or buoys, erecting blinds or other structures, or ingress and egress of researchers, and measures you will take to minimize these impacts.

The proposed research will be conducted in the Delaware River and Bay. Most of the project area is urbanized and/or industrialized. The research will not be conducted in or near a unique geographic area, nor will it impact the physical environment.

4) Briefly describe important scientific, cultural, or historic resources (e.g., archeological resources, animals used for subsistence, sites listed in or eligible for listing in the National Register of Historic Places) in your project area and discuss measures you will take to ensure your work does not cause loss or destruction of such resources. If your activity will target marine mammals in Alaska or Washington, discuss measures you will take to ensure your project does not adversely affect the availability (e.g., distribution, abundance) or suitability (e.g., food safety) of these animals for subsistence uses.

The proposed research will not affect entities listed in or eligible for listing in the National Register of Historic Places, or cause the loss or destruction of scientific, cultural, or historic resources.

5) Discuss whether your project involves activities known or suspected of introducing or spreading invasive species, intentionally or not, (e.g., transporting animals or tissues, discharging ballast water, use of equipment at multiple sites). Describe measures you would take to prevent the possible introduction or spread of non-indigenous or invasive species, including plants, animals, microbes, or other biological agents.

The proposed research will not involve the transport of live organisms. Genetic tissue samples will be collected from all shortnose and Atlantic sturgeon. These samples will be properly packaged, cooled, and shipped via a courier specializing in shipment of biological materials (i.e., samples from medical or veterinary laboratories).

Project Contacts

Primary Contact: Harold Brundage

Principal Investigator: Harold Brundage

Other Personnel:

Name	Role(s)
Matt Fisher	Co-Investigator
Sean Gorby	Co-Investigator
Tim King	Tissue Sample Disposition
John O'Herron	Co-Investigator
Ian Park	Co-Investigator
Isaac I Wirgin	Tissue Sample Disposition

Attachments

Contact - Harold Brundage C5931T5HBrundage Resume.doc (Added Aug 6, 2009)

Contact - Ian Park C18142T5Ian.ParkCV.docx (Added May 7, 2015)

Contact - Isaac I Wirgin C13438T5Wirgin complete biosketch.doc (Added Nov 18, 2014)

Contact - John O'Herron C13339T5CDriscoll Resume.doc (Added Aug 6, 2009)

Contact - John O'Herron C13339T5KRosemary Resume.doc (Added Aug 6, 2009)

Contact - John O'Herron C13339T5MMatsche Resume.doc (Added Aug 6, 2009)

Contact - John O'Herron C13339T5O'HERRONRESUME-STURGEON.doc (Added May 7, 2015)

Contact - John O'Herron C13339T5SGorby Resume.doc (Added Aug 6, 2009)

Contact - Matt Fisher C12574T5Matthew_Fisher_resume.docx (Added Apr 12, 2011)

Contact - Matt Fisher C18643T5Fisher Resume.pdf (Added Apr 20, 2015)

Location - L41440T319331 Location_action_area.pptx (Added Jun 22, 2015)

Project Description - P19331T1Publications Prepared Applicant.doc (Added Jan 27, 2015)

Status

Application Status:	Application Complete	
Date Submitted:	December 13, 2014	
Date Completed:	November 13, 2015	
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- **ESA Section 10(a)(1)(A) permit (other)**
  - **Current Status:** Issued **Status Date:** March 26, 2015
  - **Section 7 Consultation:** Formal Consultation
  - **NEPA Analysis:** Categorical Exclusion
  - **Date Cleared by General Counsel:** June 14, 2016
  - **Expire Date:** June 30, 2021

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Modification Requests

Reports